

**Special
Device
Series
No. 77**

Portable Motor-Driven Hand Tools for Wood and Metal Working

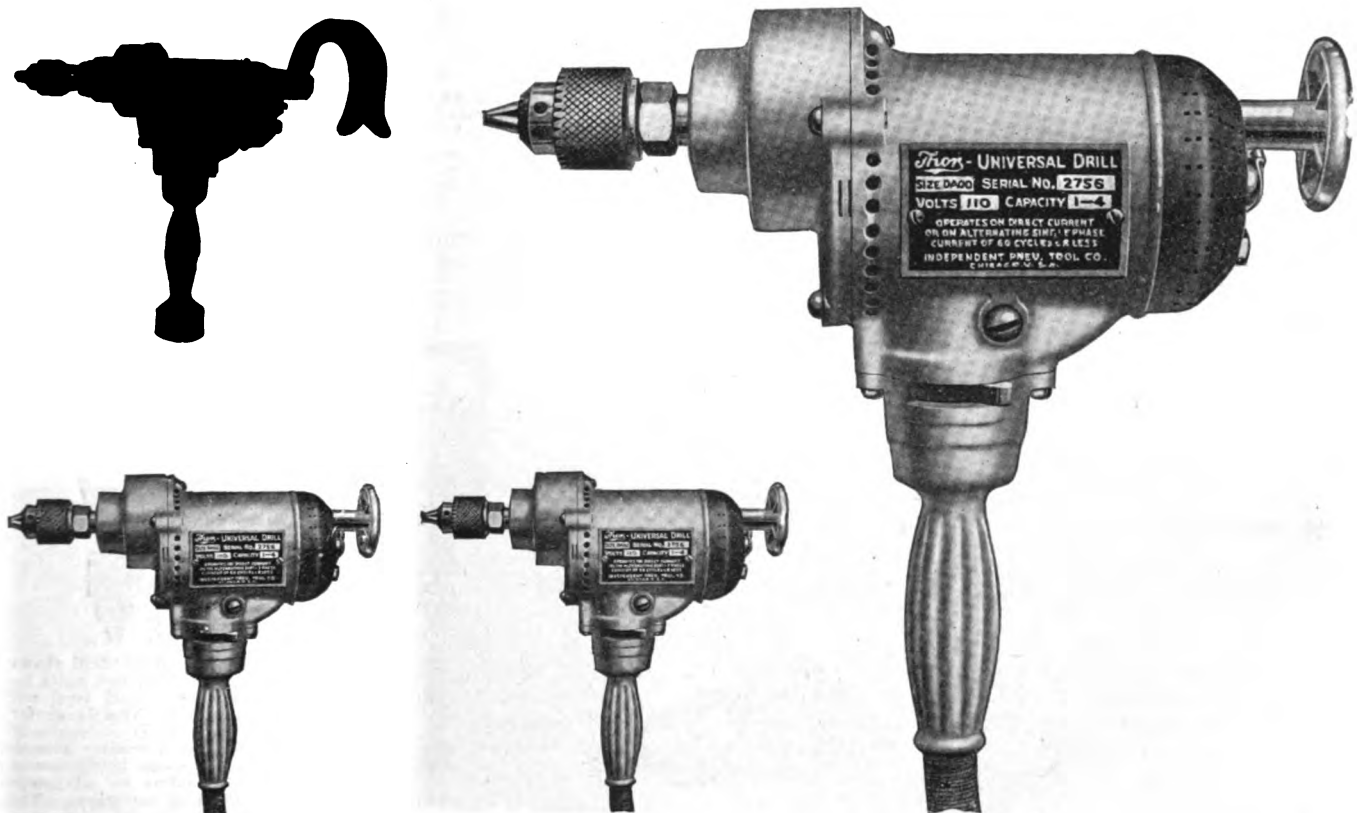
The possibilities of portable electrical tools will be of interest to every concern or individual engaged in any operation demanding manual labor. Manufacturing concerns of today are constantly facing the necessity of cutting down manufacturing and repair expenses wherever possible in order to keep down the cost of their products. By making certain classes of motor-driven tools in a portable form their field of usefulness has been so broadened that they have become an essential part of an up-to-date shop equipment. The current for operating these tools is usually taken from an ordinary electric light socket or plug receptacle. These devices are the shop man's handy tools; in fact, a miniature machine shop in themselves. In what follows, details are given covering the construction and operating features of portable motor-driven hand tools, and the illustrations serve to show the extent to which they have been developed. Motor-driven tools of the bench type will be described in a future article.

Portable motor-driven tools such as are used for wood and metal working are divided into two general classes—those of the bench type and those that are held by the workman during operation. This article deals only with the latter class, i.e., motor-operated hand tools consisting for the most part of drills and grinders.

Electric Drills of Different Types.—One kind of motor-driven drill is of the hammer type. These are used extensively for drilling holes up to an inch in diameter in concrete and soft stone as well as for light chipping of metals. The hammer blow is delivered by a motor-operated piston which actuates the drill steel or chisel so that the blow is produced by pneumatic impact. At the instant the blow is struck

the piston is running free of all mechanical parts, thereby preventing the transmission of shock or vibration to the electrical parts of the tool which might be injured thereby.

Breast drills are fed into the work by means of the pressure of the operator's body against a plate on the drill. Hand drills are equipped with a hand grip for maintaining the tool in position, while the drill is commonly fed by means of a screw attachment. Both single and multi-speed drills are made. The principal advantages of multi-speed over single-speed drills are in starting the work and in the increased production possible when drilling through soft material. Single-speed drills, however, are usually recommended by manufacturers in cases where the drill is to be operated by a person other



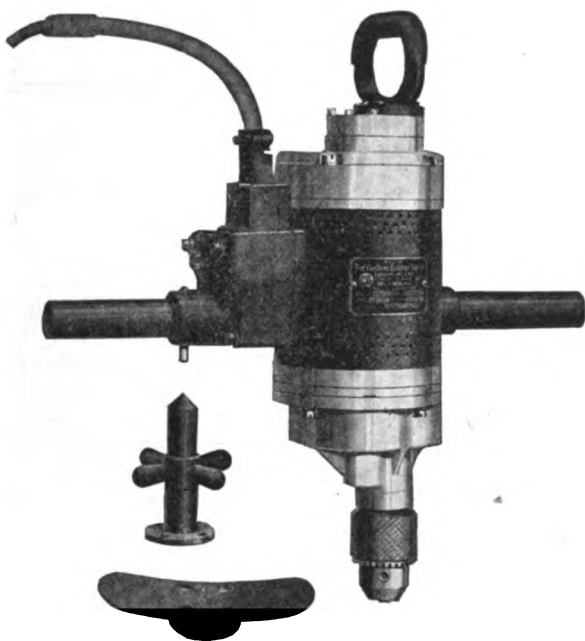
Group of portable electric drills designed for all kinds of drilling, reaming and wood boring in the building of automobiles, steel and wood cars, boilers, automobile bodies, and in railroad and structural shops, ship and dry dock work, and machinery repairs. Made by Independent Pneumatic Tool Co., 600 West Jackson Boulevard, Chicago, Ill.



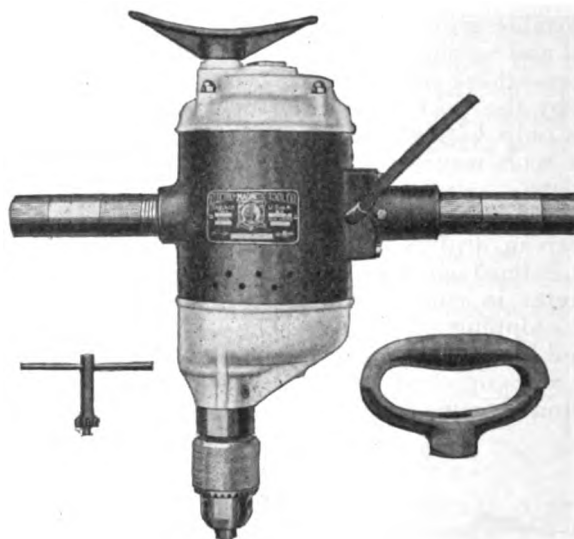
The $\frac{1}{2}$ -in. drill shown above is equipped with patented control known as the "pistol grip and trigger switch." These drills are made in sizes ranging from 0 to $\frac{1}{4}$ -in. with a no-load speed varying from 1600 r.p.m. in the smaller sizes to 850 r.p.m. in the larger drills. Made by Black & Decker Mfg. Co., 118 Commerce St., Baltimore, Md.



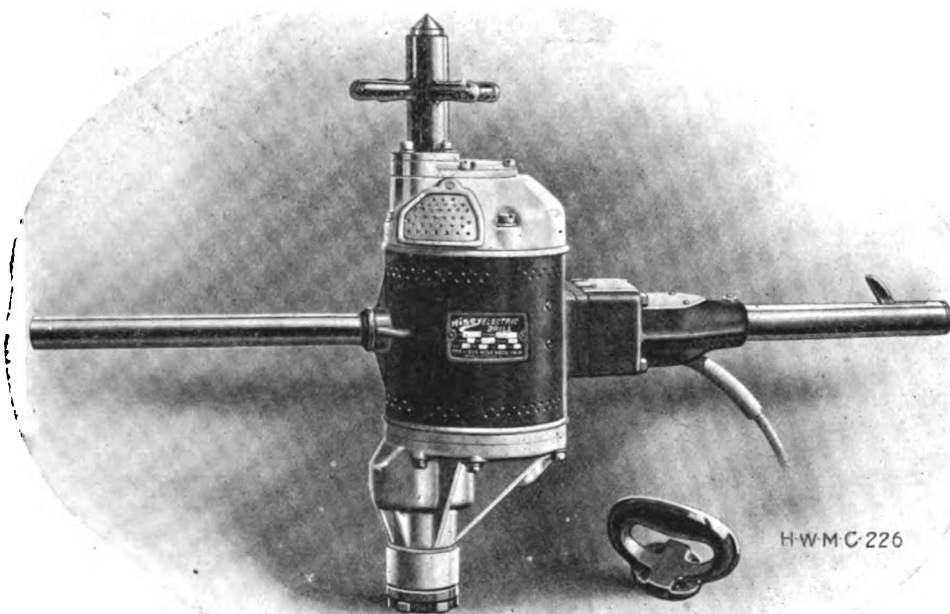
This drill has a capacity of $\frac{3}{4}$ in. in steel, weighs only 27 lb., and is equipped with a removable No. 3 Morse taper socket to take taper shank drills up to $\frac{1}{4}$ in. in diameter. The drill measures $5\frac{1}{4}$ in. by 17 in. long and has an offset spindle $2\frac{1}{4}$ in. from the center of the spindle to the edge of the frame. It is also equipped with a light weight, high power, series compensated motor which delivers a maximum output of more than $\frac{1}{2}$ hp. Made by Black & Decker Mfg. Co., 118 Commerce St., Baltimore, Md.



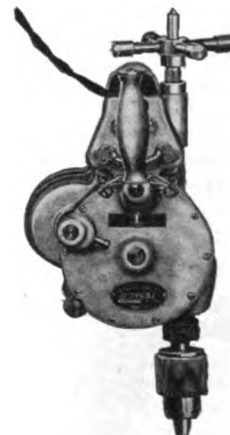
Portable electric drill adapted to all kinds of general drilling work. It will operate on either direct or alternate current, ranging from 20 to 60 or 80 to 125-cycles, single-phase. Made by Van Dorn Electric Tool Co., Cleveland, Ohio.



Portable electric drill which is furnished with spade handle or breast plate. Made by Electro-Magnetic Tool Co., 2902-04 Carroll Ave., Chicago, Ill.



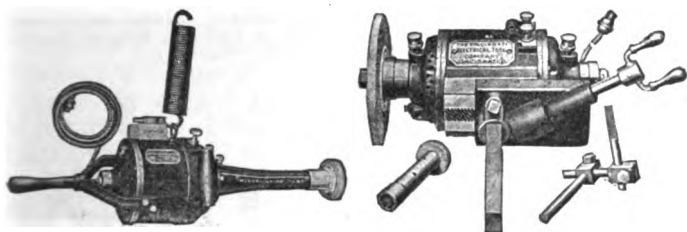
Heavy duty electric drill which can also be used as a reamer. Forced ventilation, by means of fan attached to armature shaft, keeps the temperature to a minimum at all times. Made by Hisey-Wolf Machine Company, Cincinnati, Ohio.



The portable screw-feed drill shown above has two speeds, the gears being made from hardened steel and running in grease. The lever for changing the speeds is conveniently located where it is readily accessible. The high speed being double the low speed, offers an advantage for many kinds of operations. The length, including chuck and screw feed is 16 in. This drill ranges in capacity from 0 to $\frac{1}{2}$ in. The low speed is 250 r.p.m. and high is 500 r.p.m. at no load. Made by Temco Electric Motor Co., Leipsic, Ohio.

than the owner. The reason for this lies in the fact that with the multi-speed drill, the drill should be stationary when the speed is changed, lest the gears be stripped in the process. If the operator owns the drill, he will be careful to change gears only when the drill is at a standstill, so that no injury results, whereas if the drill is the property of someone else, the operator is not likely to be so careful.

Each of these types is made in designs suitable for either wood or metal working and for operation on

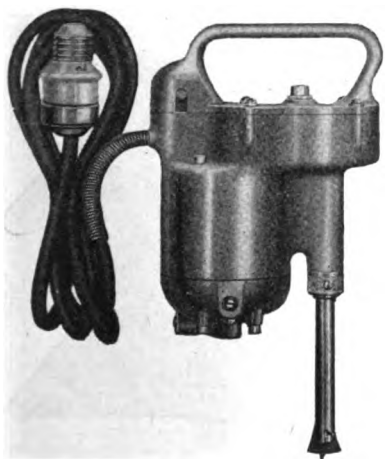


Above are shown two designs of electric motor-driven grinders. At left is shown an aerial grinder with extension for internal grinding. The portable grinder, shown at the right, is used for surface grinding. Made by Cincinnati Electrical Tool Co., Cincinnati, Ohio.

either direct or alternating current. For most drills, numerous tools such as drills, reamers, screwdrivers, dye-sinking tools, etc., are provided which widely extend their field of application. The drills, as a rule, are compact in design, rapid in operation, and lightly and conveniently handled. They are of rugged construction, accurate in their work, and economical in current consumption and upkeep, all of which appeals strongly to the operator when once he becomes accustomed to the use of drills of this type.

Electric Grinders.—This group comprises internal grinders, surface grinders, combination grinders, valve grinders and buffers. The internal grinders are used for grinding interior surfaces, while the so-called "surface grinders" are used only for outside surfaces. Combination grinders which will do either internal or surface grinding are also on the market.

Like all electrical tools, the valve grinder is a real labor saver. As a concrete example of what this tool can accomplish, it is stated that in a large automobile service station as much work can be done in thirty minutes with a motor-driven valve grinder as formerly required four hours to accomplish by hand grinding. The comparatively high speed of grinders makes them adapted for buffing work by simply substituting a buffing wheel in place of the grinding wheel.



Heavy duty type of electric valve grinder. The casing is constructed of a tough aluminum alloy and all working parts, motor shaft and grinding shaft operate in phosphor bronze bearings. The grinder complete is furnished with standard bits for slotted valve, spanner bit for Ford, valve lift spring, flexible cord and attaching plug. Made by Kalamazoo Railway Supply Co., Kalamazoo, Mich.

The electric motor-driven tool has several important advantages over the ordinary hand-power tool. Chief among these advantages is the increased production obtainable. The motor-driven tool operates at a much higher rate of speed than the hand tool and its speed is constant, whereas the operator of a hand tool must stop occasionally to rest. The motor-driven tool is the most accurate, since the workman does not become fatigued while using it.



Electric hand drill of 1/4-in. capacity which is used largely for automobile body building and for small jobs of various kinds. It has a no-load speed of 1200 r.p.m. These drills are held with the forefinger on the trigger switch, which gives perfect control at all times without changing the position of either hand. This patented control saves drill bits and has made the tool a general favorite. Made by Black & Decker Mfg. Co., 118 Commerce St., Baltimore, Md.

TYPICAL DESIGNS OF ELECTRIC TOOLS

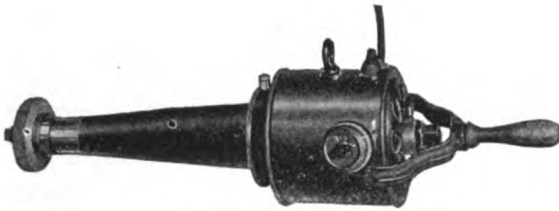
The operating principles of the various portable motor-driven hand tools now on the market are practically the same, the differences being largely confined to construction details and materials. Therefore a description of the products of representative firms will be, in a large measure, typical of the different tools on the market.

Construction of Motor-Driven Tools.—Upon the design and construction of the motor depends to a very large extent the life and service of an electric portable drill. The motors used in the drills made by one concern are of the high-speed commutator type. The armature shaft is made of nickel forging steel, and the armature core is built up from thin sheets of magnetic steel, the cores being carefully wound and insulated. The commutator is made from hard drawn copper bars, forced together under strong pressure. The mica is cut back from the surface to avoid the possibility of its protruding and preventing the full contact of the brushes. This construction also causes a current of air to pass over the armature sufficient to keep the motor cool.

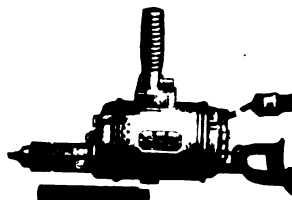
The brushes are of hard carbon and have a broad surface in contact with the commutator. The brush springs are of bronze and have a large number of coils, thus insuring a uniform tension on the brushes



Electric grinder used for grinding valves of automobile engines. It is furnished complete with cord and plug. Made by Stenman Electric Valve Grinder Co., Inc., 42 Southbridge St., Worcester, Mass.



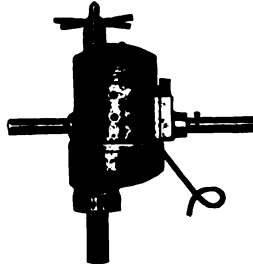
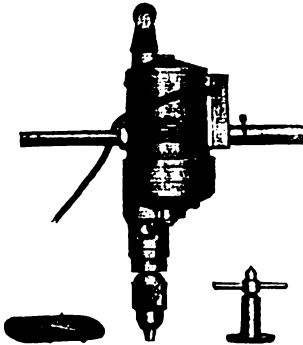
Portable electric grinder equipped with extension arm for internal grinding. Made by Gilfillan Bros. Smelting & Refining Co., 217 West Sixth St., Los Angeles, Cal.



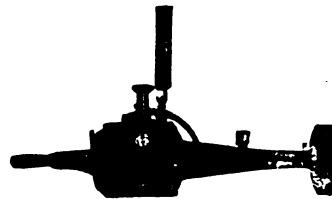
The electric hand drill shown above is made in both single and multi-speed types and has a capacity in steel of $\frac{1}{2}$ -in. It is equipped with universal type motor and operates at 450 r.p.m. low speed and 750 r.p.m. high speed. The total weight is about 18 lb. Made by Cincinnati Electrical Tool Co., Cincinnati, Ohio.



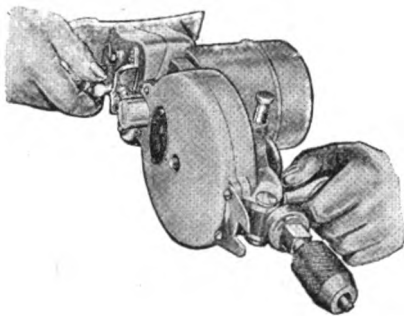
Ball bearing electric surface grinder for grinding metal or composition. It eliminates hand filing and chipping. To operate, it is only necessary to attach it to a lamp socket of direct current or single-phase alternating current. Motors for this type of grinder are also wound for 2- and 3-phase alternating current. Made by United States Electrical Tool Co., 8th and Burnes St., Cincinnati, Ohio.



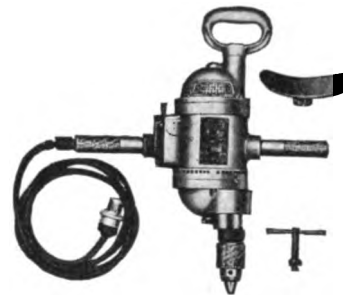
At left, motor-driven portable electric hand drill that is furnished with a breast plate, and two side handles, either of which can be used as desired. This drill has a capacity in wood of $1\frac{1}{4}$ in. and in metal of 1 in. The approximate speed of the spindle varies from 250 to 460 r.p.m. at full load. At right, heavy duty, electrically driven screw feed portable drill equipped with ball-bearing spindle and armature. The total weight of this drill is 35 lbs. and the length over all is 20 in. It will drill in hard wood up to $1\frac{1}{2}$ in. and in metal up to $1\frac{1}{4}$ in. at a speed of 250 r.p.m. Made by Stow Manufacturing Co. Binghamton, N. Y.



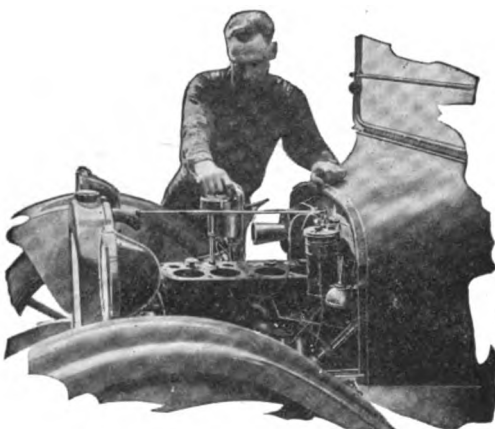
The illustration at the left shows an air-cooled electric grinder designed for grinding and cleaning castings. This grinder can also be used with a felt wheel for polishing or a sand wheel for grinding off high spots on castings after the filler has been put on. The grinder can be used in close places, and is made for alternating or direct current. At the right is shown a $\frac{1}{2}$ -in. single speed D.C. drill. This drill is built to stand the hard usage to which tools of this character are subject. Switch to start and stop drill is located in the handle. The maker claims that it will drill a $\frac{1}{4}$ -in. hole through steel $1\frac{11}{16}$ in. thick in one minute and fifteen seconds. Made by United States Electrical Tool Co., 8th and Burnes St., Cincinnati, Ohio.



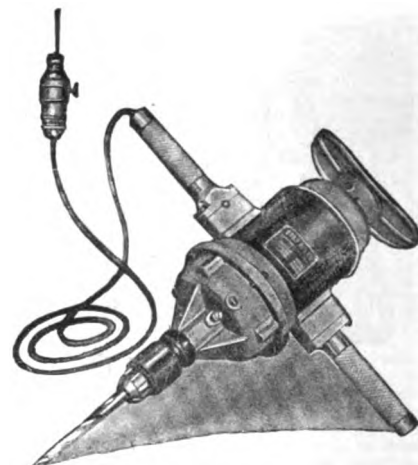
Two types of portable hand drills for use in either metal or wood working. At left is shown a drill held in the hands to illustrate the distribution of weight and the convenient location and accessibility of the switch. At right is shown a drill designed to allow close-corner drilling. It has a length over all of 14 in. and weighs 9 lb., complete with chuck. Its capacity in steel is from 0 to $\frac{1}{4}$ in. with a load speed of 600 r.p.m. The consumption under load at 110 volts is 215 watts. Made by Temco Electric Motor Co., Leipsic, Ohio.



At left, portable universal motor drill which is furnished with either breast plate or handle, as desired. The dimensions are $4\frac{1}{2}$ in. by 14 in. and the weight is 12 lb. It will drill holes up to $\frac{1}{4}$ in. in diameter. The speed under load is about 750 r.p.m. The illustration at right shows a $\frac{3}{16}$ -in. universal motor drill, for use on direct or alternating current, of 25, 30, 40 or 60 cycle. The gears are made of chrome nickel steel and hardened, and run in grease. The motor is air-cooled and of light weight, the casing being made of aluminum. The drill is equipped with ball thrust bearing on the chuck spindle. Made by United States Electrical Tool Co., 8th and Burnes St., Cincinnati, Ohio.



Showing method of using electric valve grinder on automobile. The grinder, shown above, was made by Kalamazoo Railway Supply Co., Kalamazoo, Mich. It weighs 6 lb. and can be used for grinding valves up to $3\frac{3}{4}$ in. in diameter. The motor consumes approximately 75 watts.



Heavy duty breast drill made especially to withstand severe service. Bronze bearings for the motor, a ball thrust bearing on the spindle and special treated steel gears encased in a grease filled housing are features of this drill. It will drill in hard wood up to $\frac{3}{4}$ in. and in metal up to $\frac{1}{2}$ in. The weight, including chuck, is 20 lb., and the length, over all, is $15\frac{1}{2}$ in. Made by Stow Mfg. Co., Binghamton, N. Y.

at all times regardless of wear. The fields are built up of laminations of electrical sheet of the highest quality, and the coils are carefully wound and insulated.

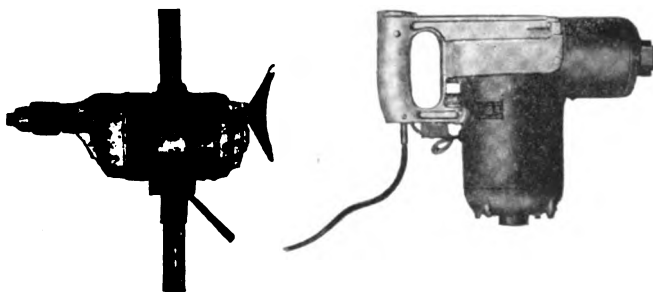
In describing its line of electric drills, another manufacturer calls attention to a patented method of control which enables the operator to control the tool like an automatic pistol. It is claimed that this increases his efficiency and at the same time makes his work easier, as he can forget the control, which is practically automatic, and can devote his entire attention to guiding the tool. This method also reduces the number of drill bit breakages, as the operator naturally tightens his grip and instinctively pulls the trigger, stopping the drill, if the drill bit catches on a burr, or when it breaks through the work. There is no danger of the drill sagging onto the bit and breaking it when the mechanic operates the switch, since the operator does not have to change the position of his hands. This fact also lessens the risk of inaccurate centering in starting the hole.

The gears used with this drill are cut from special steel, heat-treated, and are mounted on shafts ground to size, which run in generous bronze bearings. The gear train is packed in grease in a separate grease-tight compartment like an automobile transmission; consequently it gives maximum service with minimum attention.

The motor used is designed and built especially for drills and will operate on either direct or alternating current of 25, 40 or 60 cycles. The drills are made for operation on 32, 110 and 220 volts, but they will also operate satisfactorily on voltages 10 per cent above or below these values. The motor is air cooled by means of a fan on the armature shaft which sucks air in over the commutator, draws it through the housing and expels it at the opposite end. The end cover of the commutator is entirely separate from the armature shaft bearing support, and can be easily removed for inspection and adjustment of the brushes without interfering with the operation of the motor. This also prevents the binding of the armature shaft in the bearing, should the end cover be distorted by dropping the drill or by applying excessive pressure with the feed screw.

Portable Electric Grinders.—One of the advantages of a portable grinder now on the market is that it

can be operated with the shaft in a horizontal, vertical or any other position and still give the same accurate results. The motor is provided with a double set of oil cups, which insure adequate lubrication under all conditions. A quickly acting switch fastened to the attaching cable and conveniently located about 6 in. from the motor can be operated regardless of



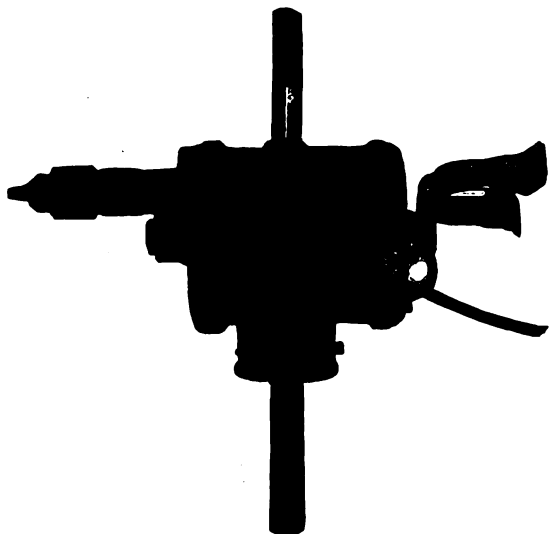
At left is shown a portable electric breast drill and at right an electric drill with a spade handle. Made by Electro-Magnetic Tool Co., 2902-04 Carroll Ave., Chicago, Ill.

the position of the grinder. The bearings are made of bronze, proportionately large, and cone-shaped to such a degree that they can be readily adjusted in either direction and can be loosened or tightened without any danger of freezing the bearing to the shaft. These bearings are adjusted from the outside of the housing without removing any part of the machine or the grinding wheel. The bearings can be removed by simply taking off the grinding wheel and one protector cap, the shaft remaining in position. The bearing on the commutator end of the motor and on the pulley end of the extension is a combination thrust and annular self-aligning imported ball bearing, by means of which either shaft will always assume its natural position after any adjustment because of wear made on the wheel end bearing.

The construction features of these grinders are very simple. They are so designed that by loosening two screws on the commutator end of the motor, the protector cap can be removed, thereby exposing and giving access to the carbon brushes, brush holders and all electrical connections, including those of the attaching cable, all of which are held by spring snap binding posts, so that no soldering is required. This arrangement permits the renewal of the attaching cable without soldering or disturbing the other connections. The direction of rotation on both direct and alternating current grinders can be changed instantly by reversing the two lead wires from one spring snap binding post to the other. The motors are designed to run equally well in either direction.

Electric Valve Grinders.—The motor used with the valve grinders made by a prominent manufacturer is capable of developing 1/6 hp., and operates from an ordinary electric light socket on direct current or on 25-, 40- or 60-cycle alternating current. It is air cooled by means of a centrifugal fan mounted on the armature shaft so that the grinder can be operated continuously without danger of overheating. The armature shaft is mounted on ball bearings and the tool runs with practically no vibration.

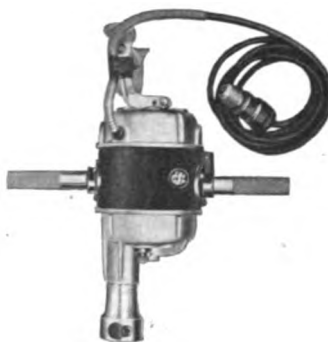
Oscillating Mechanism of Valve Grinder.—The oscillating spindle runs in a long bronze bushing against a ball thrust bearing and its movement is a long steady sweep through an arc of about 100 deg. This even movement is obtained by the use of a crank and connecting rod. The gears are cut from special steel, heat-treated, and are mounted on steel shafts ground to size, which run in generous bronze bearings. Both



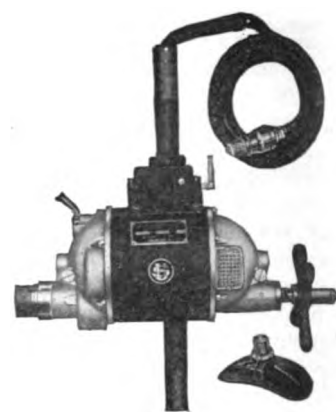
Two-speed portable electric drill which is made in 1/2-in. capacity. The first speed is 400 r.p.m. and the second speed is 700 r.p.m. The change in speed is accomplished by moving a knob on the bottom of the gear case. Made by Gilfillan Bros. Smelting & Refining Co., 217 W. Sixth St., Los Angeles, Cal.



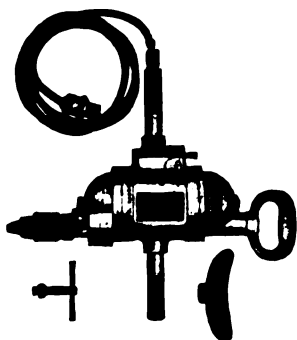
Two sizes of electric valve grinders made by B. F. S. Manufacturing Co., 54 Hermon St., Worcester, Mass. The machine, shown at the left, is a heavy duty grinder and is equipped with a 1/12-hp. motor. The "Baby" electric valve grinder at the right is operated by a 1/37-hp. motor and is designed for light work.



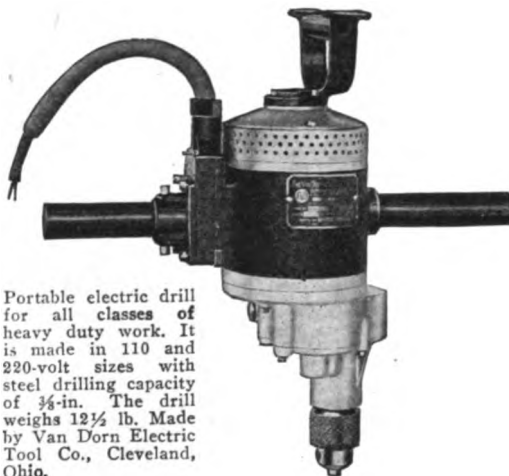
The maker points out that this drill was designed for shops requiring a tool that will stand hard usage. It is made with a large surplus of power, and can not be stalled or stopped with a 1/2-in. twist drill drilling in steel. Gears are arranged on each side of armature shaft which equalizes the pull of the shaft. The gears are encased and run in grease. A switch located in the handle furnishes means for starting and stopping the motor. Made by United States Electrical Tool Co., 8th and Burnes St., Cincinnati, Ohio.



The above illustration shows an electric drill fitted with a screw feed and carrying a No. 2 Morse taper socket. The drill is removed by taking nut off end of spindle and driving drill out of sleeve. The drill is fitted with a switch in handle to start and stop same; also fitted with breast plate for countersinking and wood drilling when desired. Made by United States Electrical Tool Co., 8th and Burnes St., Cincinnati, Ohio.



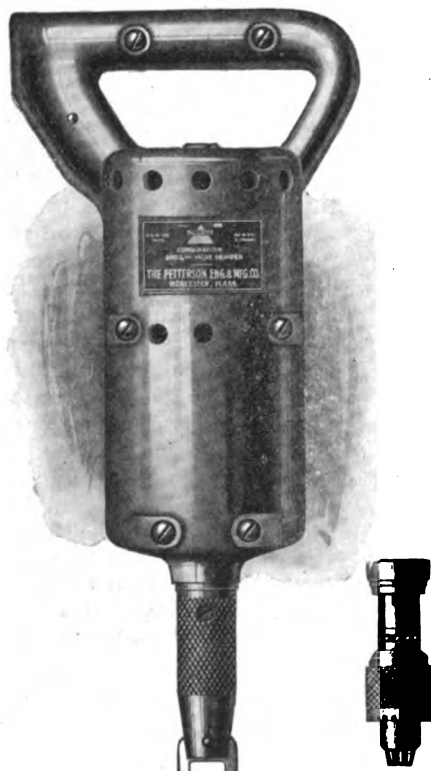
A 1/2-in. universal drill, weighing 12 lb., and having a speed under load of 750 r.p.m. Made by United States Electrical Tool Co., 8th and Burnes St., Cincinnati, Ohio.



Portable electric drill for all classes of heavy duty work. It is made in 110 and 220-volt sizes with steel drilling capacity of 3/4-in. The drill weighs 12 1/2 lb. Made by Van Dorn Electric Tool Co., Cleveland, Ohio.



A screw feed type of portable electric drill. Made by Cincinnati Electrical Tool Co., Cincinnati, Ohio.



Combination electric drill and valve grinder which is 18 in. long and weighs 6 lb. When not in use grinding valves, it is available for small miscellaneous drilling so frequently a part of the day's work in any repair shop. Made by Petterson Eng. & Mfg. Co., Worcester, Mass.



Electric valve grinder which is designed to operate on 82, 110, 220 or 250 volts. This grinder is 18 in. long and weighs 5 1/2 lb. Made by Petterson Eng. & Mfg. Co., Worcester, Mass.

the gearing and oscillating mechanism operate in grease in a grease-tight compartment, like an automobile transmission.

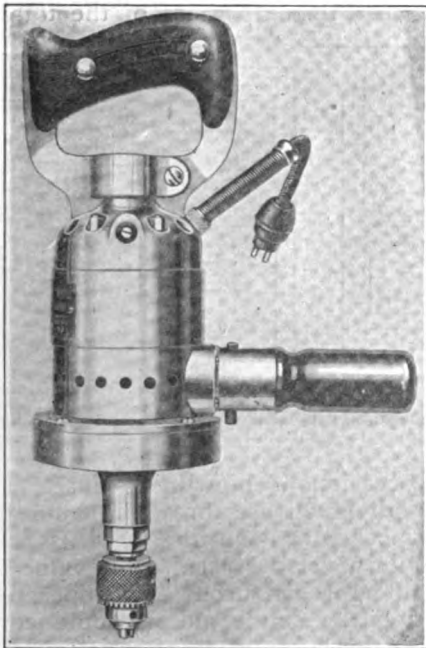
CARE OF ELECTRICAL TOOLS

The manufacturers give a number of suggestions covering the care of electrical tools, the observance of which will increase production, give a longer life of tools, and in general cause greater satisfaction to both the owner and operator. If the tool loses its power, it should be ascertained if the brushes are worn out, or if the commutator needs to be cleaned. It is possible, also, that the brushes may be stuck in the brush holder. Care should also be taken to see that the tools are oiled.

In case the tool refuses to start, the commutator end of the casing should be taken off, the switch thrown on, and if no sparks can be seen on the brushes, the attachment plug should be removed from the lamp socket and the lamp inserted in order to determine if the power is on. If it is, the commutator end of the drill should be removed to see if the brushes are bearing on the commutator; the commutator also should be observed, and if it is black or looks as if oil were on it, it should be wiped off with a piece of cloth dampened with some kerosene, after which the current may be tried on the drill. If it then refuses to run, the commutator should be examined to see if there is a burned spot between two of the bars. If so, the armature should be removed and returned to the factory. It is always best to return the tools to the factory, as the expense for repairing them is small.

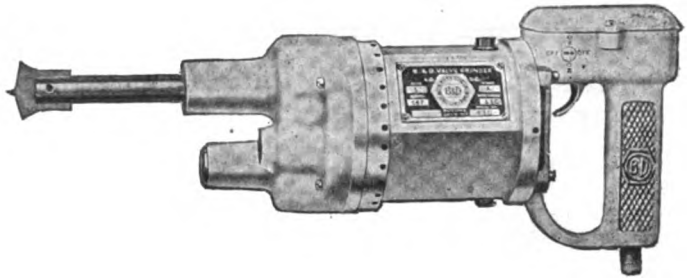
Perhaps the most important point to be observed in the operation of an electric grinder is the necessity of keeping the wheel trued up. A wheel which is not round will cause a heavy blow to be struck on the arbor each time the high spot hits the work, resulting very shortly in serious damage to the bearings. Operators should be cautioned not to try to use the tool for grinding when the wheel that does not run true.

Ample lubrication should be provided at all times.



Portable electric drill which has aluminum housing to give balance and lightness without sacrifice of strength. It weighs 8 lb. with chuck, and its length overall is 18 in. This drill has a capacity of $\frac{1}{4}$ in. in steel and similar metals. A 110-volt, universal type motor is used which will operate on 35 to 60-cycles. Made by Arnold Electric Tool Company, Inc., 908 Chapel St., New Haven, Conn.

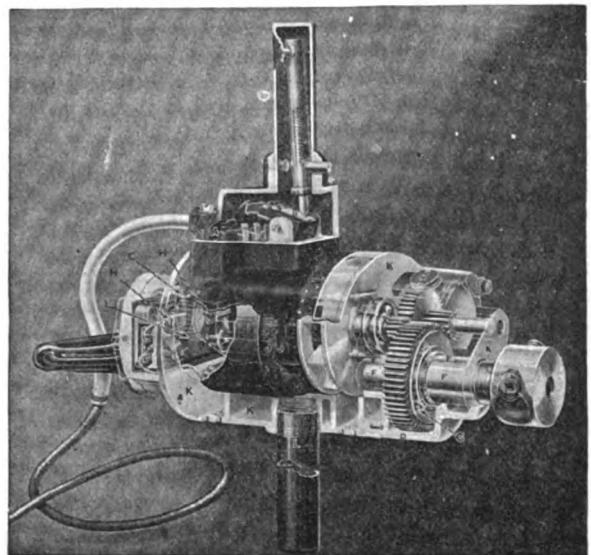
Grease cavities or cups are provided for non-fluid oil and should be constantly kept reasonably well filled. The commutator and brushes should be examined occasionally to see that excessive wear is not taking place on either part. To permit the brushes and commutator to be examined without difficulty, these parts



In this valve grinder the oscillating action of the spindle is free and steady. It is the same movement that skilled mechanics use when grinding by hand, only it is much faster. By means of a trigger switch the current can be switched on or off without removing either hand. It weighs, complete, 8 lb., and is made for operation on 32, 110 or 220 volts. Made by Black & Decker Mfg. Co., 118 Commerce St., Baltimore, Md.

are generally enclosed by covers which can be removed by the operator. The commutator should be kept fairly clean and the brushes should not be permitted to wear too short. The brush holders are provided with springs of the clock-spring type, which give a uniform pressure through a wide range so that no adjustment is required after leaving the factory. The brush holders are carefully set in position for proper commutation and should not be tampered with. No. 00 sandpaper is one of the best materials for cleaning the commutator, emery cloth should never be used for this purpose.

When grinders are being examined it is a good plan to clean out the air holes in the housing and enclosing covers. These should be cleaned from the inside, if possible, so as to remove the dirt instead of pushing it into the machine. The wheel should not be pressed on so hard that the speed is reduced below that shown on the name plate of the tool. By observing this rule more work can be accomplished with less energy consumption and without endangering the windings of the tool.



Sectional view showing construction details of portable electric drill. A—cable connection direct to switch, B—switch, C—armature bearings, D—gear case, E—bronze bearings, F—drive spindle, G—drive spindle thrust, H—brushes, I—commutator, J—motor, K—casing, L—side handle. Made by Van Dorn Electric Tool Co., Cleveland, Ohio.